

Summary of Fish Facilities Technical Team Recommendations

1. Diversion structures should be located on-bank.
2. Diversion structures should not exceed 3,000 cfs in capacity at any single location with a total maximum of five diversion structures at five sites on the lower Sacramento River.
3. Diversion structures should be located on hydraulically appropriate sections of the river to optimize screen performance and to avoid sedimentation or scour at the intake.
4. Two potential diversion sites downstream from Steamboat Slough should be considered in addition to five upstream locations. Any potential downstream diversion sites would be in lieu of upstream locations for a total of 5 diversion structures.
5. While locating diversion structures at least 1 mile apart is generally desirable, closer spacing could be acceptable to assure that each location meets the critical siting conditions (e.g., adequate river depth and bank geometry).
6. Provide a positive, physical fish screen barrier between fish and water diversions.
7. Avoid the need to collect, concentrate, and handle fish passing the diversions.
8. Avoid the need for fish bypasses that concentrate fish and increase the risk of predation.
9. Avoid creating areas where predators may congregate or where potential prey would have increased vulnerability to predation.
10. Avoid siting diversion structures at areas of existing riparian habitat.
11. Use the most biologically protective fish screen concepts as the foundation of the proposed designs.
12. Diversion structures should be as short in length as practicable to reduce the duration of fish exposure to the screen surface. Diversions should be designed to operate at an

approach velocity of 0.33 fps to minimize screen length, however, to minimize impacts to delta smelt, the diversions should be operated to an approach velocity of 0.2 fps at night if delta smelt are suspected to be present, based on a real-time monitoring program. The diversions may be operated to an approach velocity of 0.33 fps at all other times.

13. Required sweeping velocities for the diversions should be measured adjacent (within twelve inches) to the screen face and should be equal to or greater than the approach velocity criterion (i.e., 0.2 fps or greater when operating at an approach velocity of 0.2 fps, and 0.33 fps or greater when operating at an approach velocity of 0.33 fps).
14. Target the height of fish screen panels to fifteen feet of submerged screen height to operate at 0.33 fps approach velocity at low river stage; taller screens may be appropriate at specific sites for purposes of reducing the length of the diversion structure. If the screens are constructed 40% taller (additional 6 feet), when the river stage exceeds the design minimum, the extra water depth will allow increased diversion capacity while meeting a 0.2 fps approach velocity (during critical times when delta smelt are present).. Further refinement of the relationship between screen height and river stage should be addressed during an optimization process associated with final design.
15. Bottoms of screen panels should be elevated three to five feet off the existing river bottom to minimize sediment and bed load impacts, and to limit exposure to benthic-oriented fish species.
16. An approximate distance of 100 feet for spacing between refugia is suggested however, final refugia spacing should be further evaluated prior to final design. In order to optimize design, construction, operations and maintenance, the refugia should be modular systems that may be installed in any fish screen slot.

17. Dimensions of the fish screens, refugia, and other diversion components should be standardized where possible for all five diversions for economies of scale and operational flexibility.
18. Civil works should be compartmentalized to allow dewatering of some sections for maintenance while other sections are in operation.
19. Flow control baffles should allow diverted flow to be distributed vertically as well as horizontally along the screen face to distribute flow evenly over all operating screen area. Dynamic baffling should be considered to automatically regulate flow through discrete portions of the screen. Selective withdrawal to allow water to be diverted from selected areas of screen (vertically or horizontally) should also be considered.
20. The design of the diversion structures should consider the risk of introduction of quagga and zebra mussels and other invasive species to the lower Sacramento River system, in order to minimize effects to operations and maintenance of the diversion structures and fish screens.
21. Physical and biological studies are necessary to complete diversion facility designs and to evaluate each diversion facility. Recommended pre- and post-construction physical and biological studies are provided in Tables 1 and 2, respectively. Table 1 lists the near-term aquatic study programs needed prior to construction to reduce key uncertainties and improve the diversion and fish screen design. Table 2 identifies the post-construction aquatic studies and monitoring activities needed to ensure screens are meeting performance criteria and if projects are phased, to allow for design improvements to subsequently-constructed diversion structures.